HOW TO TEACH WOOD FINISHING

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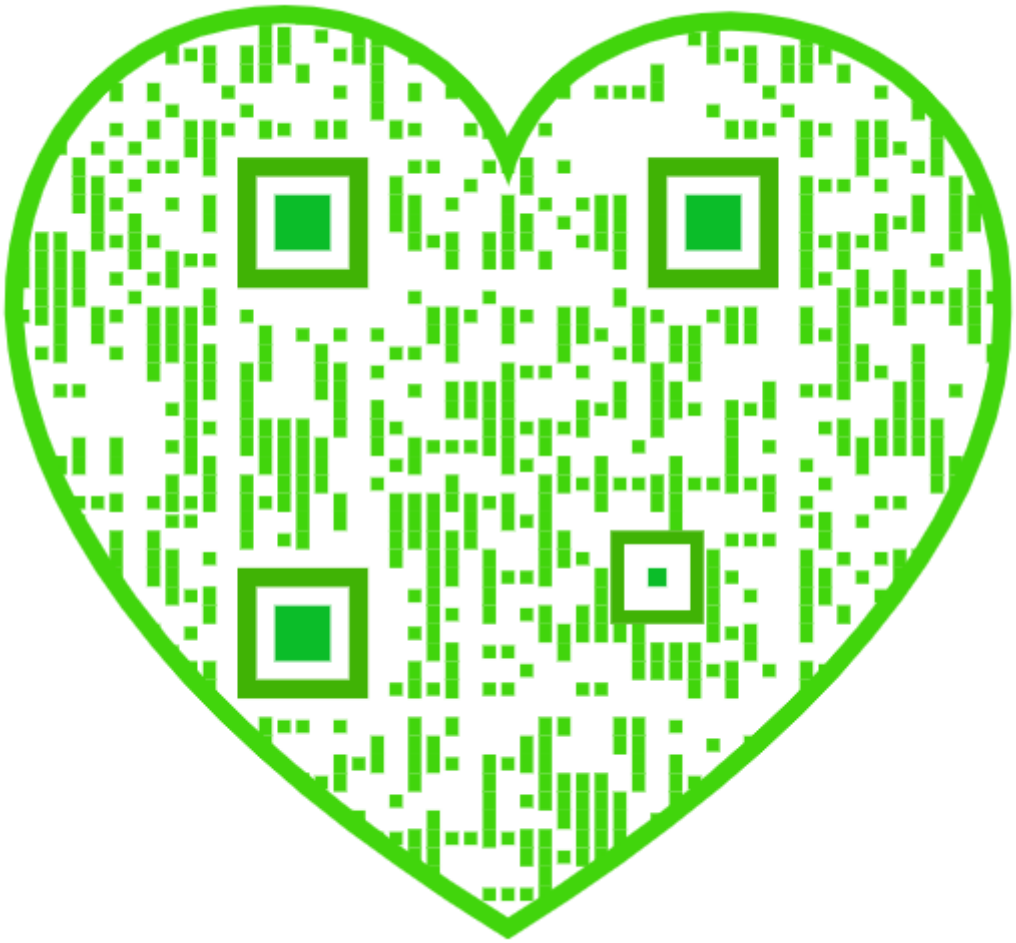
FRANK HENRY SELL



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HOW TO TEACH

WOOD FINISHING

BY

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PREFACE

Essentials Made Clear. In presenting this book to school shop teachers the author desires to make clear the fact that it is not expected to cover in an exhaustive manner the subject of wood finishing. Neither is it intended to answer all questions that might arise in simple problems of this class. Its object is to consider only those problems that properly belong to the school shop giving only such directions and information as are desirable for such work. In this manner it is hoped to avoid obscuring the needed in the needless and thus encourage a more definite and continuous study of wood finishing in the school. The author hopes to lessen greatly the common practice of guessing at methods because needed directions are buried in a mass of general information on all sorts of finishing problems. In order to use this book successfully it should be thoroly read in the order written, studied if necessary, until understood.

Master Each Page. Beginning with this preface master each page in the order given. Teachers of shopwork or others wishing extensive for-

mulas or directions can find them in various large works on varnishing, staining, etc.

Order of Topics. The contents are arranged in the order in which they should be studied. We have treated definite problems rather than given general directions without regard to any specific case. This makes possible very brief, specific, yet readily understood directions. These being fully comprehended, their application to a large variety of problems is obvious and easy. The table of contents affords an easy method of learning where each method or style of finishing is treated. A well-arranged index facilitates the finding of any topic desired.

Variety of Finishes. Altho specific problems are considered, and each type of finishing described as it would be applied to a specially suitable article, almost any article mentioned might be finished with any of the finishes given.

Materials. The various finishing materials are discussed in considering the processes in which they are first used.

CONTENTS

Why Do Finishing - - - - - - 7
The Fundamentals - - - - - - 8
Fool Proof Finishes - - - - - 11
Preparation of Woods - - - - 13
Finishing Cutting Board - - - - 16
Sandpapering Finish - - - - 23
Grinding Finish - - - - - - 26
Preparing Spruce and Fir - - - 31
Finishing Bread Board - - - - 32
Use of Fillers - - - - - - 33
Fillers - - - - - - - - 34
Stains - - - - - - - - 38
Staining Bread Board - - - - 41
Rottenstone - - - - - - 42
Finishing Book Rack - - - - 44
Finishing Book Trough - - - 45
Finishing Waste Paper Basket - - - 47
Varnishing - - - - - - 50
Where to Get Materials - - - - 52
The Index - - - - - - 53

SUCCESS

The basis of success in any line is to start right and take each step with definiteness and promptness. We should avoid haste, never passing over a problem until mastered. We should be ever active, never stopping to go over again that which is already completed.

WHY DO FINISHING

Several Reasons. There are several reasons why great care should be taken in the finishing of even the first pieces in woodwork. To finish the pieces gives an excuse for careful truing and smoothing. The finish adds much to the appearance of the work, probably much more in the estimation of parents and friends than of the pupils as they are more interested in what they learn than in the project.

The chief reason, however, is that in doing the work of finishing the pupil learns several principles of large consequence in all his work and learns them quicker and better than he can by doing anything else. Some of these are very essential to success in all his shop work and cannot be taught so effectively in any other part of the work. This is well understood by teachers of Mechanical Science.

Educational Value. After a series of most careful tests the author is thoroly convinced of the great educational value resulting from correct methods of teaching shellacing of the simple pieces of the first lessons. Where success in using shellac is not attained it will be found that correct methods have not been used.

THE FUNDAMENTALS

Schools Differ. Sometimes we see work well finished, sometimes poorly finished. Sometimes nearly all the work of one school will be quite satisfactory, while that of another will be quite as discouraging. In attempting to get proper results in any school the first step is to get a clear understanding of the fundamentals. If one examines very closely the work of some schools, he will notice a similarity in the defects of the work whether stained, varnished, painted or shellaced. The work of another school may be closely inspected with the result that such defects as are found differ materially from those of the other school but likewise appear to arise from some one fundamental error.

Master Fundamentals. Were we dealing with the problems of the commercial shop we should find these fundamentals so numerous and so greatly varied as to make our task of considering them a most serious one. In the school shop, however, these fundamentals that need to be considered are not numerous, and an earnest teacher, willing to do the right, ought soon to master them and gain satisfactory results. The chief difficulty is that habits have been formed that are in the way of success, and in some cases when one discovers that to succeed certain fixed habits

must be changed the price is considered too high, and the old habit with the indifferent result is retained. In other cases some theory, long held sacred, is found to conflict, and rather than give up a theory we accept the consequent resulting inferior work.

Depends on Previous Work. There can be little hope of helping any who are not freely willing to lay aside all previous notions that conflict with proper methods. These statements are made preparatory to stating a fact usually overlooked by shop teachers. It is this: SUCCESS IN FINISHING DEPENDS PRIMARILY UPON THE FUNDAMENTAL HABITS OF WORK THAT HAVE BEEN DEVELOPED BY THE PUPILS BEFORE THEY ATTEMPT ANY SORT OF FINISHING. Unless this previous training has been correctly given there is no rule or method possible by which well-finished surfaces can be obtained. If this previous training has been accomplished, then the pupil in the fifth or sixth grade will use white shellac successfully as has often been demonstrated. In fact, wherever Mechanical Science is taught according to the author's methods, pupils will be found in their first year of shopwork getting results that are thought by old-line teachers to be utterly impossible for pupils of such grades. It is therefore very essential for us to realize from the very first that unless our pupils have been properly prepared to do this class of

finishing we will not get such results as the use of this book is expected to give.

Preparation Necessary. Let us therefore consider briefly the preparation necessary for this work. First: The pupil should have learned to examine a surface or edge definitely and systematically. This should have resulted from his study of planing. Second: He should have learned to go over his work systematically and thoughtfully. By the time he is ready to use shellac he should have formed the habit of knowing exactly what his hands are accomplishing, not in a general way, but definitely as to each movement. All rapid, thoughtless movements, so noticeable at first, should have ceased and the boy, tho in the fifth or sixth grade, should move slowly and thoughtfully yet accomplish much. Those not familiar with the Mechanical Science work should study carefully the text on woodwork for use in the grades and also the teacher's handbook.

True Surface. With the pupil properly prepared to take up the study of finishing there should be a true and smooth surface on which to apply the finish. No matter what grade is truing a surface it should be true as understood by a mechanic, and smooth, before attempt is made to finish it. There is absolutely no excuse for permitting pupils to attempt to finish work that has not been properly trued and smoothed.

Suitable Piece. There is also the further requirement that the piece to be finished should be of suitable shape for the study of finishing. If the pupil is to learn something, the conditions for learning should be suitable. To attempt to teach finishing on any piece that may come to hand is rank nonsense. It is therefore a matter of great importance that the problems of the shop should be selected with due consideration of finishing as well as of woodworking.

"FOOL-PROOF" FINISHES

What to Avoid. One of the difficulties met by most school shop teachers is that of keeping away from those finishing materials that are advertised as being so simple and easy to use as to avoid any possibility of improper use. We are told that if we will use such and such stains and coatings that we will get the very best results every time as they are of such a nature as to give proper results in the hands of any pupil. Some dealers go so far as to call their stains "Fool-Proof." The use of one coat stains with wax finish is also entirely out of place for most of the school work. The use of pigment stains and wax should not be tolerated in any part of the school work. As teachers, wishing to do our pupils

some good, we should look upon all such preparations and the firms who recommend them in the same manner as we should an arithmetic and the firm offering it with the guarantee that any fool could surely work any problem in it.

Shellac Suitable. The one essential of every stain or finishing material of any kind for school use is that it will not give proper results unless used in the proper manner. Any tool or material that will permit of careless or thoughtless use should be eliminated from the school shop. The finishing, when properly carried on by the use of suitable materials, becomes one of the most valuable parts of the school work. This is why shellac has no equal as a finish for woodwork in the fifth and sixth grades. That it can be used successfully has been so thoroly demonstrated as to leave no doubt of its successful use by every teacher who employs proper methods.

Like Using a Key. To use "Fool-Proof" finishing materials is simply to admit that one does not know how to teach finishing and is willing to resort to such a subterfuge in order to make a showing of work rather than to teach the pupils. Any teacher who resorts to the use of such materials or methods should be classed with teachers who permit their pupils to work problems by the use of a key and then exhibit the problems as showing the pupils' knowledge of the subject.

PREPARATION OF WOODS

Different Classes. In preparing the surface of wood to receive the finish we must keep in mind that different woods require different treatment, and also that for different finishing materials and different grades of finish there should be a different treatment of the wood surface. Probably the better way to learn and understand these problems of the finishing room is to study the methods of finishing various woods beginning with soft, even-textured woods such as basswood, soft pine, gumwood and pencil cedar.

Following these studies we may study the finishing of the hard pines, fir, red cedar, spruce, cypress and similar woods. One can readily understand that such woods as oak, ash, chestnut and mahogany cannot be finished as readily as those of more even texture. Rosewood may be considered an extreme of this class.

Preparing Pine. Beginning with soft pine we have probably the easiest wood on which to begin our study of finishing. Being soft it is easily bruised or scratched and corners and edges may be ruined before we are aware of having touched them. Our first caution, therefore, is to preserve the corners and edges with the utmost care as explained in directions for sandpapering given in "WOODWORK FOR THE GRADES." That rounded

corners and edges are the mark of the shiftless workman is not the only reason for being careful. After the finish is complete you will readily recognize the inferior appearance of such places by the indefinite and inartistic reflections of light from places that are not truly up to form.

Removing Defects. Next to keeping the outline in shape is the removal of minute surface defects. The Mechanical Science pupil should have no trouble with plane marks, for long before finishing the cutting board the problem of planing should be solved and there should be no noticeable plane marks to remove. It is therefore only a matter of following the directions for sandpapering and reducing the surface to a velvety smoothness with substantially all noticeable scratches removed.

Filling Defects. Sometimes there will be defects such as worm holes that need to be filled. This may be accomplished in several ways, one of which is to use a little coarse sawdust and glue, another is to use putty. Large holes should be plugged as directed in "ELEMENTARY CABINETWORK."

Putty. The ordinary putty of commerce is made of whiting and oil. Frequently some material is substituted for the whiting. This usually results in a putty that will not stick to the wood. A much more durable putty is made by mixing into ordinary putty from one-fourth to

one-half of white lead. An excellent way in which to keep putty from drying down hard is to put it into a tightly covered glass dish, usually a large-mouthed bottle. Packed tightly in such a place it will keep fairly well for years.

For school use a very small amount of putty should last a year. Putty to use in bad joints should not be thought of, for in well conducted Mechanical Science classes there will be no bad joints. To fill an occasional worm hole, or cover the head of a brad is about the limit of use for putty in the school shop.

In case the putty becomes too hard it may be softened by working into it a very small amount of linseed oil. It may be made by taking the dry whiting, sometimes called putty powder, and mixing in enough oil to give the desired consistency.

Cold Water Putty. There are on the market several "cold water" putties. Some of these are excellent and are to be preferred to whiting putty because they dry hard quicker and do not shrink in drying. For plugging worm holes, etc., they give better results than whiting and oil putty.

Coloring Putty. Whiting putty may be colored by use of stains and also by use of common colors ground in oil. Some of the cold water putties are colored the same as whiting putty, some take the color of the stain used on the wood so perfectly as to require no special coloring.

Be sure in all work using whiting and oil putty to do the puttying several days before the varnishing so that the putty can have time to shrink, and then be worked down smooth. The surface should then be ready for the first coat of finish.

FINISHING CUTTING BOARD

Kind of Wood. This board, (Fig. 117, WOODWORK FOR THE GRADES), should be of pine, basswood, whitewood, or some other soft and even-grained wood. Before beginning the finishing the surface should have been sandpapered as directed. Care should be taken that the last sandpaper used is fine enough to remove all the readily visible scratches. No paper is fine enough not to scratch the surface. For finishing this board we use white shellac because long experience in school shopwork has demonstrated that it is by far the best material to use in the first lesson on finishing.

Shellac. Shellac is procured from a tree of India. It has many uses other than those in the finishing room. There are two forms of shellac on the market. They are usually distinguished by the color. One is yellow and is sold in flakes. The other is white and is sold in large sticks or ropes very similar in both color and appearance to the large mass of white taffy candy as it is being pulled in the candy shop.

Purchasing Shellac. Shellac may be purchased pulverized ready for dissolving in alcohol. Either kind of shellac may be purchased in the dry form or in the form of a varnish-like liquid. The yellow shellac will keep in the dry flake form for a long time and may be dissolved in denatured alcohol. This may be had from the local dealer. The white shellac quickly spoils so that it cannot be dissolved and therefore it should be purchased in the liquid form or else dissolved as soon as received.

Preparing Shellac. The proportion of alcohol to shellac varies with different dealers. A good recipe is to use four pounds of shellac to one gallon of alcohol. This will be thick enough for almost any use. It is very easily reduced, if required, by adding more denatured alcohol.

Do not use wood alcohol for this purpose, and do not plan to keep the white shellac for more than six months. It may be kept for several months in tin cans, but it is far better to keep it away from the light in glass cans or in stone jugs. All should be kept tightly corked.

Experience with a large number of pupils and teachers has shown that some are apt to use it too thick on all their work and others will waste time and materials by using it too thin. No rule can be given that can be applied except by a good deal of careful study and experiment.

Therefore, be ever on the alert to judge whether the coating applied was correct or too thick or too thin.

Shellacing. Place the bottle of shellac where it can be reached easily while holding the board so that the light will strike the surface and be reflected towards the eyes as shown in Fig.1. Dip the brush into the shellac so as to take up a considerable surplus, and then remove that on the outside of the brush by wiping both sides on the mouth of the bottle. There is great danger of wiping the brush too much as well as too little. Unless sufficient shellac remains in the brush to flow out freely the coating will be uneven. Begin next to one edge, at a distance from the top end of the back surface. Lower the brush while

Fig. 1. Shellacing.

moving it towards the bottom end. As it moves towards the lower end press a little harder so that the same amount of shellac will leave the brush at each point. Continue the stroke entirely out to the bottom end, Fig. 2. The common mistake in using shellac is carelessness in going over the surface and then attempting to remedy the mistakes by going back over the places that have been missed or attempting to brush out thick places. The shellac dries so rapidly that it should be brushed onto the surface evenly the first time. If there is any occasion to go back over the freshly shellaced surface great care should be taken to brush the shellac out evenly at both ends and sides. At the finishing of the stroke relieve the pressure enuf to avoid scraping the brush over the lower edge. Fol-

Fig. 2. Shellacing.

low the down-stroke with an up-stroke, Fig. 3, beginning near the center and passing the brush entirely to the top end. Fig. 4, Page 21.

Fig. 3. Shellacing.

Continue this process brushing the shellac first downward then upward each time covering a strip a little less in width than the width of the brush. Always be sure to lap the strokes both at the ends and at sides so that there will be no thin or uncovered spots.

Holding Piece. Only by the most thotful, definite systematic work can the best finish be produced. The one feature that in school is likely to cause more trouble than any other is to get the pupil to hold the piece so that the surface and shellac are always clearly visible.

Avoid Dust. After covering the entire surface in this manner the board may be laid in the bench drawer to dry, if the pupils have individual drawers. If not, it should at once be placed in the wall case away from the dust. Dust does not entirely ruin such a finish but it does injure it. Were it varnish a very little dust would entirely spoil it.

Examining Surface. The surface may be examined by holding it up to the light in both hands and moving it about until the light has been reflected from every portion to the eyes.

Fig. 4. Shellacing.

Shellacing Edges. After the shellac on the back surface has dried, which will usually require but an hour or so, the edges and second or front

side should be shellaced. Begin by shellacing the farther end, next the left hand edge, then the nearer end. In order to apply the shellac to an edge the brush should be turned edgewise to the length of the edge and should be moved very carefully to avoid working the shellac over onto the side. Any streak of shellac on the side at the edge will add a great deal to the labor of finishing and therefore great care should be taken in shellacing the edges.

Shellacing Second Side. After the two ends and edge are shellaced, proceed to the front side, going over it systematically, beginning at the left hand edge. The right hand edge is the last surface to receive the shellac. By this time the young finisher should begin to notice carefully the effect of each stroke of the brush. He should also notice the effect of leaving more or less shellac on the brush and the need of carefully wiping the end of the brush on the edge of the bottle. The piece should now be laid away until returning to class next day. It should then be sandpapered as described under the next topic "SANDPAPERING FINISH."

These directions for shellacing the cutting board apply to all simple one-piece objects made of close even-grained wood. For directions for shellacing taborets, tables and similar objects, see "SHELLACING TABORET."

SANDPAPERING FINISH

Sandpapering Finish. The cutting board or some similar one-piece object made of close, even-grained wood should be the first on which to study sandpapering a finish. Before attempting to do finishing one should have thoroly mastered sandpapering of plain wood surfaces, both with the block and without. It will then be readily understood that no block should be used in sandpapering a finish.

Fig. 5. Sandpapering

Holding Piece. Take a piece of sandpaper, not more than one-fourth sheet, in the hand as shown in Fig. 5 and go over the surface, lightly at first and always parallel with the grain. Always hold the piece so that the light is reflected directly to the eyes as shown. Gradually increase the pressure upon

the paper until it cuts as rapidly as it can without heating and pulling up the shellac. It will soon be noticed that directly under the places where the most pressure is applied the sand paper rapidly fills with the shellac. It is therefore necessary frequently to change the position of the fingers so that every part of the sandpaper will be used equally.

Rubbing Thick Places. After a very little rubbing it will be noticed that some parts of the surface are much rougher than others. This necessitates the careful observation of the work and extra rubbing over the thick or rough places. This is really the important and difficult part of the process, but should be readily learned if one has first learned to use sandpaper on the unfinished surface.

Using Scraper on Finish. Dust, even dirt, in the atmosphere of the school shop is usually unavoidable and therefore some will find its resting place on the freshly shellaced surfaces. In attempting to smooth surfaces in which dust has settled and become embedded it will be quite difficult to smooth down the dust and the small raised spot of finish about it without cutting away too much of the finish on the adjoining surface. The same is true of exceptionally thick spots of finish. It is therefore necessary to remove these exceptionally high places by some means that will not hit the level surface. This

may be accomplished by using a carefully fitted scraper, working very lightly, usually with one hand only and always holding the piece to the light as in applying the finish or in sandpapering.

Always use a newly sharpened scraper and be sure that the burr is keen and even, otherwise it will leave scratches on the finish. Hold the scraper as nearly vertical as it can be made to cut. Do not attempt to do the work of the sandpaper with the scraper. Usually a very little scraping of the finish is sufficient.

Sandpapering Near Edges. The most difficult places to work down smooth are those near the ends that have been made exceptionally rough by carelessness in applying the shellac. As soon as these are discovered they should be rubbed down. This should be done before rubbing the central part because by so doing it will be more easily accomplished and the final surface will be much better. Frequently the sandpaper can be used to better advantage if it is torn into one-eighth sheet size pieces. Sometimes even smaller pieces are advisable. In every case the paper should be as carefully torn as in first tearing the sheet and it should always be used folded double.

Sandpapering Edges. After rubbing this side to a smooth surface, turn to the opposite side and smooth it. After smoothing the sides, smooth the ends and edges, being careful to observe the

same directions for using the sandpaper so as to avoid round corners as in the sandpapering of the wood before shellacing. See "WOODWORK FOR THE GRADES," Figures 123 to 127.

Shellacing, Second Coat. After all surfaces and edges have been worked down smooth and even, wipe the board thoroly and apply another coat of shellac to the better surface only. Should the piece be chamfered, the ends and edges should be shellaced. But one surface is fully finished as the back side is to be used for cutting upon and therefore should not be highly finished.

Repeat the process of shellacing and rubbing down with sandpaper until the surface is well and evenly covered with shellac. This usually will require two or three coats. Then after the sandpapering use pumice stone as directed under the side head, "USING PUMICE STONE."

GRINDING FINISH

Pumice Stone. After the OO sandpaper has been used on the second or third coat of shellac the surface will yet be far from smooth. On the first coats the sandpaper will be sufficient as it will leave the surface smooth enough to receive the succeeding coat of finish, but as the finish nears completion more care must be taken to have a smooth surface to receive the coating and

the final rubbing down must be far better than can be accomplished with OO sandpaper. It is therefore necessary to prepare the work to receive the last coat of shellac or varnish by rubbing down the finish with pumice stone. The same process is repeated on the last coating.

Grades of Pumice Stone. Pumice stone may be obtained in three grades of powdered stone and also in bricks. For school use only the powdered is required. A convenient form in which to purchase it is in ten pound packages. The coarsest is marked "F," the finest "FFF". Which grade to use must be learned by use and experiment. The coarser the grade the faster it will cut, but if too coarse it will leave unsightly scratches in the finish that cannot be removed. The beginner may well use "FF" for preparing the surface for the last coat and "FFF" for rubbing the last coat. This may be considered as being on the safe side.

Rubbing Oil. By using the powdered pumice stone dry little could be accomplished. Some liquid must be used to make it work freely. Almost any liquid that will not dissolve the finish may be used. Water is no doubt the cheapest. Cheap oils of various sorts are also used. It is well for the shop teacher to experiment with such as are at hand. There is also to be had an oil especially for this purpose called "rubbing oil."

It is a thin and rather inexpensive oil, and for most schools its use will be found preferable to that of water or other oils. Common machine oil thinned with kerosene can be used when but little is needed and no other is at hand.

Oil Cans. The rubbing oils are best used from a small machine oiler. To avoid the trouble that follows confusion with the cans used at the oilstones the can containing the rubbing oil may be painted black. Black shellac can be used for this purpose.

Using Pumice Stone. Take a small wad of cotton waste or a small piece of rubbing felt and pour a little oil upon it. Dip this into the box of pumice stone, or sprinkle a little of the powder on the finish. Rub over the entire surface using a circular motion. After working in this manner for a short time, wipe the surface clean and examine it. Look for the thick or rough places. Take more oil and powder and repeat the rubbing, using the circular motion unless the nature of the high places requires a different movement. After the first inspection one should be able to see fairly well where rubbing is required without having to clean off the oil and powder. Too frequent cleaning of the surface is a waste of both time and material.

The process of grinding with pumice stone follows so closely in principles that of using sand-

paper that one who has learned to use sandpaper should have little difficulty in using pumice stone.

This is especially true in regard to keeping edges sharp, using the waste or felt so it will not overhang the corners or chamfer, and in working down the high spots along the corners before completing the central part of the surface. If the sandpapering has not been thoroly mastered the directions should be reviewed while using the pumice stone.

Listen for Grinding. If the oil and pumice stone are in proper quantities the grinding should be distinctly heard. The proper proportioning of the two ingredients to form a thick paste is a matter of chief importance and can be learned only by experience. By listening for the sound of grinding and changing the proportion to make this sound as distinct as possible will soon result in the proper use of the material. It also must be borne in mind that pumice stone is rapidly used up. More powder and more oil must be added frequently.

How Long to Grind. The grinding should be continued until the shellac or varnish is cut to a smooth mirror-like surface, unless by so doing it will be cut down too close to the wood. If the finish is not thick enough to permit of being ground down to such a smooth surface it should be worked to as smooth a surface as will be safe

without cutting thru to the wood. It then should be thoroly cleaned of all oil and powder and have another coat of finish applied. Often it is necessary to do a large part of the rubbing parallel with the grain as in sandpapering.

Number of Coats. This applying of finish and rubbing down should be continued until the desired smoothness of surface is obtained. If shellac is used it may require several repetitions of the rubbing and shellacing. Varnish usually has a greater body than the shellac and therefore does not usually require so many applications. Do not make the mistake of leaving too thick a coating of finish after the first sandpapering or first grinding. See that every part is as thin as it can be made without cutting thru before applying another coat.

Grinding Two Coats at Once. After one has become expert in applying and rubbing finish two or more coats may be applied for each sandpapering or grinding. This will save time and yet result in a good finish, if the workman is sufficiently skilled to apply the coats evenly. This should not be attempted until one has had considerable experience in working one coat at a time. It is sometimes advisable in finishing open-grained woods to apply a part of the shellac across the grain. The last coat should always be applied parallel with the grain.

PREPARING SPRUCE AND FIR

Hard and Soft-Grained Woods. Next to the smooth surfaced woods are those that are in one sense smooth, yet difficult to finish because they are made up of two distinctly different sorts of grain, one hard and smooth, the other very soft and smooth.

Difficulties in Finishing. These two kinds of grain do not smooth or finish alike. The first appearance of difficulty in working such wood is in planing. The plane must be sharp or it will not cut the two grains to an even surface. Some of these woods, such as fir, spruce and Washington red cedar have such a soft grain that it is extremely difficult to sandpaper the surface without cutting away the soft grain much faster than the other and thus produce a peculiar roughness that makes good finishing impossible.

Smoothing. There are various ways of overcoming this difficulty, among these is the one that should never be omitted, that of taking a finishing cut over the surface with a very sharp plane. If a scraper is to be used it also should be very sharp. On all such surfaces but little sandpapering should be done. Sometimes the better method is to go over the surface with a coat of liquid filler or shellac, permitting this coat to dry hard and thus harden the soft grain.

After this it will be found much easier to use either the scraper or sandpaper.

Staining Before Shellacing. If the piece is to be stained it will be necessary to determine whether stain should be used before or after this hardening coating. In some cases stain should be applied both before and after. It will be noticed that after the surface is shellaced stains are not as readily absorbed and therefore will not give the same tone of color as when applied before the shellac.

After a surface is produced on these hard and soft-grained woods in this manner they may be finished the same as basswood, etc., of the first group. See "finishing cutting board".

FINISHING BREAD BOARD

Kind of Wood. Should the bread board, (Fig. 143 "woodwork for the grades,") be of pine, basswood or similar close, even-grained wood it may be finished in the same manner as the cutting board. We will therefore consider only the finishing of such bread boards as are made of oak, mahogany or similar open-grained woods.

Preparing Oak. To prepare properly oak and other open-grained woods for finishing in the best manner is a somewhat difficult matter. The first difficulty is to produce an even surface. It is so

easy to tear out spots of crooked grain or to leave bunches in the hard places and holes in the soft ones. To avoid this always finish planing with a sharp plane and then follow carefully the directions for scraping as given in "WOODWORK FOR THE GRADES." The illustration showing how to hold the scraper at different angles should be thoroly studied.

Grade of Sandpaper. Often after careful planing and scraping the surface is ruined by sandpapering. Too fine a paper is used and then to make it "take hold" it is pressed hard on the surface with the result that the soft grain is literally dug out leaving the hard grain above the soft grain the same as on a weather-beaten board.

USE OF FILLERS

Filling the Grain. Even the best of care in sandpapering cannot make a perfect surface because the wood is full of holes, pores, and these must be filled in order to provide the smooth, tight surface necessary to sustain a polish or varnish finish. It is possible to fill these pores by applying many coats of shellac or varnish, and each time rubbing off most of that which adheres to the surface. This, however, would be a tedious and wasteful process. The better way is to apply some material that will fill the pores but not adhere to the surface.

FILLERS

Paste Fillers. The usual method of filling these open grains is by use of what is known as paste fillers. These may be obtained at any paint store prepared for use except that they require thinning. Usually directions for use will be found upon the label or wrapper. The process of using them can be stated in a few words and appears to be quite simple, yet the best results are usually not obtained except by the experienced finisher. By having clearly in mind what is to be accomplished by the filler and then proceeding carefully, noting the effect of each part of the work, one should soon be able to do fairly good filling on any kind of wood.

Preparing Filler. On opening the can the filler usually will be found settled and quite hard. Perhaps it can be softened by stirring into it the liquid, probably oil, found on top. If not, remove a portion of the mass to another suitable receptacle and pour over it enough oil or turpentine to make a thin, cream-like liquid when thoroly stirred.

Thinning Filler. If the wood to be filled is to retain its natural color, use for the thinner turpentine, otherwise linseed oil may be used, also a little drier, a liquid preparation which is used in paints, fillers, etc., to cause them to dry more

rapidly. Where a variety of small pieces are to be filled as in the school shop it is probably better to use an all turpentine filler.

Linseed Oil. This is of two kinds, raw and boiled. If space and funds are limited, only the boiled oil should be used. This is a little thicker and dries a little quicker than the raw oil. It can be used for all the purposes of the school shop.

Turpentine. Only the pure turpentine should be used in the school shop. For the ordinary school shop it may be purchased a gallon at a time. It is highly inflammable and should be kept in a place secure from heat or liability of fire or electric sparks. The place in which it is kept should be always clean of dirt or dust, and cotton waste, cloths or similar materials should not be kept in the same box or cupboard. If it can be arranged, it should be kept in a metallic case or asbestos or sheet metal lined cabinet. Both alcohol and linseed oil should be kept in similar cabinets.

Coloring Fillers. The filler may be colored by use of ordinary pigments such as rose lake, burnt sienna, burnt umber, etc. These are most easily used when ground in oil and may be purchased in small cans.

Colors in Oil. Fig. 6 tells better than words how such colors are put up. Half pound and pound tins are large enough quantities to pur-

chase at one time. Few of these colors are required. The usual list contains only Burnt Umber, Burnt Sienna and Rose Lake. To these may be added for variety such other colors as circumstances may suggest. The cans should be kept as tightly closed as possible and the pigment should be kept covered with oil or turpentine, either of which may be used for thinning.

Filling. After the filler has been thoroly

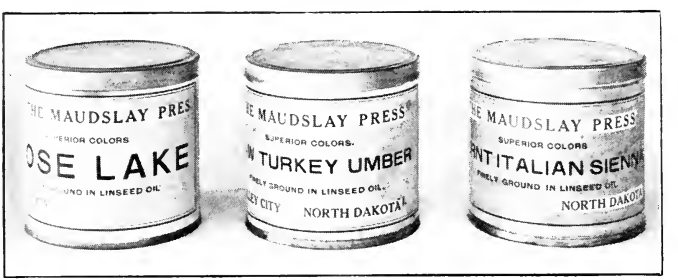

Fig. 6. Colors in Tin Cans

mixed, thinned and colored, if required, it should be applied with a stiff brush. Do not try to paint it over the surface as one would apply a coat of paint, but rather rub it onto and into the surface, rubbing in all directions and leaving but little on the surface.

Rubbing Filler. Go over a small surface in this manner and then wait until the filler becomes so dry as to rub up on the surface in a

thick paste. With a bit of waste or cloth rub over the surface, varying the movement from crosswise to circular and lengthwise, having in mind that the object is to get as much as possible of the filler into the pores of the wood.

Cleaning Surface. Next rub all the surplus filler off the surface, finishing by rubbing lightly but thoroly with clean waste. Be very careful that the filler in the pores is not rubbed out. This process of filling should produce a surface suitable for shellacing or varnishing.

Sandpapering Filler. After the filler has thoroly dried the surface should be gone over lightly with sandpaper. Be careful to rub down any rough places or spots of filler that have not been properly cleaned from the surface. Sometimes the filling process will raise the grain of the wood. In that case considerable sandpapering will be required for all the raised grain must be worked down smooth. See topic "RAISING THE GRAIN."

Staining Over Filler. Before the shellac is applied a stain may be used, either to intensify the color used in the filler, or if the filler has been left white, to do all the coloring after the filling has been done. Often all the color is given by the filler, thus avoiding the expense and time of a special coat of stain. When stains are used they should be selected and applied as directed in the following chapter on stains.

STAINS

Kinds of Stains. There are four kinds of stains known to painters and varnishers. They are: First, Oil Stains; Second, Water Stains; Third, Spirit Stains; and Fourth, Chemical Stains.

Oil Stains. These are similar to a colored varnish, are difficult to apply satisfactorily, and do not give a high quality of finish. They are more in the nature of a paint upon the surface of the wood than a stain to enter and color the wood fibres. They are not suitable for school use and should be avoided. On the other hand, altho very difficult for the beginner to apply, one who has learned the principles of applying finishes as taught in the use of shellac should, with a little practice, be able to follow the directions for applying oil stains; the difficulty is to apply them evenly so as to avoid thin spots and laps.

Water Stains. These are one kind of chemical stains, as they depend to some extent upon the action of the stain upon the wood fibres. They also act as a dye or coloring matter. Such stains are produced in a very great variety of shades and of a great variety of materials. Some give good results and are much used while others give lifeless, mud-like coatings.

The only safe way is to purchase only samples or very small quantities at first. After finding

those that are suitable, be cautious about changing. Directions for use will usually be found on the package.

Mixing Water Stains. For most water stains the powder is mixed with water and then applied with a brush or cloth. Almost any way by which the surface of the wood is wet thoroly and evenly all over will give as good results as the stain is capable of producing. With some water stains it makes little difference whether the liquid is applied evenly if it is thoroly wiped before it dries.

Sandpapering Water Stains. Such stains raise the grain and therefore the wood must be well sandpapered after the stain is thoroly dry. This will usually necessitate another application of the stain and another going over with sandpaper. The grain may be raised before applying the stain. See topic "RAISING THE GRAIN."

Finishing After Staining. After the desired color has been obtained and the wood made smooth, the finish may be completed by applying a coating of wax as described under the topic "WAX FINISHING" or it may be covered by something in the nature of a varnish, such as shellac, some of the commercial substitutes for shellac, or a varnish. As a matter of economy, varnish should be preceded by a paste or liquid filler.

Spirit Stains. This class of stains is used very largely as well as the water stains. They consist

of a liquid and a coloring matter mixed ready for use. They dry quickly. The essential qualities of durability, brilliance or "life" vary greatly with different makes and with different colors of the same brand.

Selecting Stains. It is not safe to buy these stains on the recommendation of dealers or of practical workmen. The requirements of the school are such that ordinary commercial requirements are not a guide for selection. The commercial shop might use a stain because it is a few cents cheaper per gallon, or because it dries two or three hours sooner. In the school shop where each project requires such a small amount the quality should not be sacrificed to price. In drying no stain will dry in time to receive the next coating the same class period and therefore if it dries in time for the recitation of the succeeding day it is quite sufficient. The one matter of quality should control.

This is essential not simply for the sake of the appearance of the completed finish, but because in putting on and working with a high grade finish there is much more for a pupil to learn. The clear high quality stain offers an opportunity for care in working it into the surface that is not possible with the dull, muddy preparations. Avoid the use of such colors as cover up the grain and natural beauties of the wood.

Use Few Colors. Do not attempt to use a large variety of colors. A few thoroly studied are far better than many daubed on without a proper working down to bring out their best quality.

Black Shellac. A very fine color for some work may be obtained by mixing into shellac ordinary lampblack. This will give a dead black finish resembling ebony. It may be brightened by rubbing down smooth and applying a thin coat of white shellac.

STAINING BREAD BOARD

Applying Stain. For our bread board that has been filled, we will use a spirit stain. If it is of mahogany we may use a dark mahogany stain. Apply it with a stiff brush, rubbing it on thoroly and then wipe off with cotton waste or old cloth. Be very particular to leave the surface an even color free from streaks or spots of unwiped stain. Sometimes it is well to stain but one side of the bread board so as to show the effect of staining.

Finishing After Staining. After the stain has become thoroly dry, which should require not more than one day, it may be carefully looked over and sandpapered lightly if necessary. Following this, the bread board should be finished in white shellac the same as the cutting board. This should result in a much better finish than

that of the cutting board. Therefore after the shellacing has been completed and the last coat rubbed down with pumice stone, a final polish may be given the surface by use of rottenstone.

ROTTENSTONE

When to Use Rottenstone. Unless the wood is very carefully smoothed and the shellac or varnish has practically a perfect surface the use of rottenstone will only increase the apparent roughness. If the finish is sufficiently perfect to permit of a high polish the use of rottenstone and oil will give the finishing touch of beauty and gloss that for most work is quite desirable. There is but one grade of rottenstone. It is to be obtained in either powdered form or chunks. For school use always purchase the powdered rottenstone. Only a small amount will be required.

Using Rottenstone. In using rottenstone proceed the same as in using pumice stone. Finish by rubbing carefully parallel with the grain. Use great care to keep it free from dirt or dust and avoid using waste or pads that have been used with pumice stone. This should complete the finish and leave the surface smooth and mirror-like. Avoid placing anything against such a surface for several days as the rubbing has a tendency to soften the finish.

FINISHING A TABORET

Preliminary Study. In many ways finishing a taboret (Figures 180 and 192, "WOODWORK FOR THE GRADES") is the same as finishing a cutting board or bread board. Therefore all the directions given for those problems should be thoroly mastered before attempting a taboret.

Finishing in Angles. The top of the taboret may be finished before being fastened to the rails. In that case it would be finished the same as the breadboard, except, being larger, a little more care would be necessary. In finishing the rails and legs we meet with the difficulty of working on surfaces that join other surfaces so as to form angles that are not easily reached. If we have done our previous work well this new problem will be readily solved. The chief factor is to apply the finish to the angle first and then work out towards the center of the rail, being careful to have the shellac or other material spread evenly. Remember that any surplus finish close up in the angle is very difficult to rub down when dry, therefore, wipe the brush thoroly and go back to the angles and clean them out at once.

Proceed Systematically. Go over the work systematically so that no parts will be overlooked. Begin at a point that will permit of handling the frame until the last surface has been covered. In

sandpapering or rubbing with pumice stone, work into the angles first and then out upon the large surfaces. Sometimes the pumice stone can be worked in the angles by using a pine stick or paddle instead of the usual pad or cotton waste.

Finishing Before Putting Together. The finishing of Fig. 195 "WOODWORK FOR THE GRADES" may differ from that of Figures 180 and 192 by being all done while the legs are separated from both the rails and shelf, thus avoiding finishing in angles. There are many other projects illustrated in "WOODWORK FOR THE GRADES" that are especially desirable for school shopwork because they may be finished entirely before putting together. Work planned in this manner may be very highly finished or polished by pupils in the seventh or eighth grades. All of these articles may be polished with rottenstone. Several of the projects in "ELEMENTARY CABINETWORK" may be finished before assembling.

FINISHING BOOK RACK

Selecting Wood. This book rack, (FIG. 209, "WOODWORK FOR THE GRADES,") may be made of any cabinet wood. For our own purpose in teaching the use of an oil finish we will make it of some hard and dark-colored wood such as rosewood or black walnut.

Oil Finishing. The wood should be prepared in the same manner as for other finishes. Take linseed oil, either the raw or boiled, and coat the rack thoroly. Were many to be finished they might be dipped in the oil and then tilted up to drain and dry. After becoming partially dry the entire surfaces should be thoroly rubbed. If this does not result in a sufficient amount of finish another coat of oil may be applied and similarly rubbed. The more rubbing the better.

Difference in Oils. The boiled oil dries a little quicker than the raw oil. Either may receive a little drier. Probably the raw oil will give the better surface if one is willing to apply a sufficient number of coatings and do enough rubbing. Oil finish must not be confused with "hard oil" finish which is really a kind of varnish.

Where Used. Oil finish may be used on any project but is not as desirable for large pieces as for small ones because it does not protect the wood from the effects of heat and moisture as well as a shellac finish or a good varnish.

FINISHING BOOK TROUGH

Where Wax Finish is Used. We have in the book trough, (FIG. 241, "WOODWORK FOR THE GRADES,") an article well suited to a wax finish. Wax finishes may be used on almost any piece of

hard wood furniture, but are better for some styles than for others.

Preparing Surface. The surface for a wax finish should be prepared in the same manner as for other finishes altho it is not likely that small imperfections of material or workmanship will be as noticeable in a wax finish as in a varnish finish.

Various Methods of Wax Finishing. Several methods of using the wax may be followed depending upon what grade of finish is desired. The wax may be used directly on the wood without stain, filler or any under coating whatever. It also may be used over a carefully filled and stained surface. Open-grained woods may be thoroly prepared as if for varnishing, so that the wax will form an even and glossy polish.

Applying Wax Finish. However the surface is prepared, the wax, which may be a common floor wax, is rubbed on and then thoroly rubbed down. Some wax preparations are in liquid form and may be applied with a brush. They also differ in color. On dark, open-grained wood use a dark-colored wax. There is little danger of having any trouble in putting on such a finish. It is therefore a very poor finish for school use as a pupil may learn nothing worth while tho spending days in rubbing it. Wax finish is the extreme opposite of a shellac finish as a problem for the school shop.

FINISHING WASTE PAPER BASKET

Suitable for Varnish. We may take as a suitable example for a varnish finish the waste paper basket, (Fig. 281 "WOODWORK FOR THE GRADES.") As dust is very injurious to varnish we will need in our school varnishing to apply it to some object small enough to be quickly placed into a clean case or box.

Preparing Wood. For our varnishing lesson we will use mahogany for the staves of the basket. They must be very carefully planed and sandpapered. We have already seen how the grain of the wood is raised by applying some kinds of finish. If we wish to do an exceptionally fine piece of work we must raise the grain and then smooth it by another sandpapering before we apply any finish.

Raising the Grain. This is accomplished by sponging the surface with warm water. Some use the merest trace of glue in the water. This, however, is not necessary unless the fibres of the wood are inclined to tear up or become fuzzy. In that case the glue tends to harden them so that they will work smoother. The water must not contain sufficient glue to leave any perceptible trace on the surface, for it would affect the succeeding coatings. In the use of some spirit stains the use of any glue whatever will affect the

finish. Be careful to use but moisture enough to wet the surface. Dry it thoroly and then rub down with sandpaper to a perfect surface. It should seem even smoother than before sponging.

Filling for Varnishing. The surface is now ready to proceed with the finishing. If an open grain, as would be the case with mahogany, it should be filled with a paste filler. See "FINISHING BREAD BOARD." It may also be stained and after the staining it may be finished by shellacing. In this case we are to use varnish and therefore we should use but one coat of shellac and then use the varnish. We may omit even one coat of shellac, using instead some preparation that will form a suitable basis for the first coat of varnish. There are many preparations on the market for this use. They may all be classed as liquid fillers. Their use is required because two things are necessary in preparing the surface of wood for varnish. The surface should be smooth. It also should be capable of holding the varnish out. Open-grained woods are filled with paste filler to give a smooth surface the same as the close or even-grained woods.

Purpose of Liquid Filler. Should a coat of varnish be applied to such a surface a large proportion of it would sink into the wood. In some spots it would stay out, thus making a very uneven surface and requiring a large amount of

labor to prepare it for the next coat. To avoid this condition the paste filler or the smoothed surface of the close grained wood is given a coat of liquid filler. Such a preparation should close the minute pores, so that the succeeding coats will not settle into the wood, and should be readily smoothed.

Shellac when used as a first coater over a paste filler or for the first coat on a close-grained wood to be followed by varnish may be called a liquid filler and is quite as serviceable as any that can be obtained. It is much more expensive than some liquid fillers and because of price is often displaced.

Kinds of Liquid Fillers. There are a great many sorts of liquid fillers on the market. The large variety is no doubt due to attempts to produce a liquid filler equal to shellac but at less expense. In the commercial shop these other preparations are no doubt to be preferred in most cases. For the school shop shellac only is sufficient except over certain patent stains that, because of their special composition, require a special filler over them. In purchasing a stain always make inquiry in regard to the other preparations to be used with it.

After the liquid filler has become dry and been thoroly smoothed with sandpaper it is ready to be varnished.

Trouble From Dust. There is one insurmountable difficulty in most schools to the doing of good varnishing. This is the lack of a dustless room. It is therefore necessary to confine this work to the quick drying varnishes. These are not usually the best and most durable, yet the general method of use is such that when one has learned to apply and finish these quick-drying varnishes one should have little difficulty in using any varnish, if conditions are favorable.

VARNISHING

When to Use Varnish. In no case should the use of varnish precede that of shellac. This is not because shellac is easier to apply, but because it is the better material to use in teaching the fundamentals of finishing and varnishing. Experience has shown that pupils will readily do varnishing after having used shellac.

Shellacing and Varnishing Compared. The essential difference between shellacing and varnishing is that the varnish, being slower drying, can be gone over several times if necessary. It also may be put on in an excessively thick coating and then taken up by going over a second time, thus insuring a full coating on all parts. Often it is better to apply the varnish across the grain, then parallel with the grain, and finish by

going over it very systematically, wiping up with the brush all excess. Each time the brush is raised in wiping up, it should be wiped across the wire of the varnish can.

Varnishing First Side. In the main the application of varnish is the same as that of shellac. Therefore review carefully the directions for shellacing the cutting board. Place a stick in a screw hole of one of the sides of the waste paper basket and varnish the edges and one surface. Place the piece at once in a case away from dust.

Varnishing Second Side. After this side is dry enough to handle, varnish the other side. When dry enough to work, sandpaper down carefully and apply another coat. Continue varnishing and rubbing down the same as in shellacing except that two or three coats should be sufficient to give an excellent finish.

Covering Varnished Work. Varnish may be used on a great variety of work, altho carvings and intricate shapes can be better finished in shellac. As in shellacing, all corners must be worked carefully to avoid "crying" or thick spots. If the piece must dry in the shop room, cover it at once with a heavy, clean paper, held off the surface, but close enough to exclude dust. Covers may be made for this purpose of heavy wrapping paper, building paper or tag board. When not in use they will fold up flat.

WHERE TO GET MATERIALS

Best Place. The best place at which to buy anything is of your local dealer, providing he has the article that you need and sells it at a reasonable price. Sometimes local dealers persist in keeping only such lines as are entirely unsuitable for school shop work.

Securing List of Materials. If you are unable to get suitable materials in your local market, or are in doubt as to what makes or grades to purchase, the publishers of this book will send you a list of materials and addresses of firms of whom they may be purchased, providing twenty cents in postal money order or stamps is enclosed with your inquiry, or if an order for books to the amount of one dollar or more is sent with cash remittance no charge will be made for advice and lists of materials.

In writing be sure to tell exactly for what the materials are wanted. We should know the kinds and amounts of wood you are using, the number of pupils in each grade and also whether your room is well lighted and well heated.

INDEX

	PAGE
Black Shellac	41
Black Walnut	44
Book Rack,—Finishing	44
Book Trough	45
Bread Board	32, 41
Classes of Woods	13
Cold Water Putty	15
Coloring Fillers	35
Coloring Putty	15
Cutting Board	16
Defects,—Removing	14
Depends on Previous Work	9
Dust	50
Edges,—Shellacing	21
Educational Value of Finishing	7
Fillers	33, 49
Filling Grain	33
Fir	31
Fool Proof Finishes	11
Fundamentals in Finishing	8
Grinding Finish	26, 29
Habits	8
Holding Piece	20
Linseed Oil	14, 35
Mahogany	32, 47
Materials,—Where to Buy	52
Number of Coats	30

Oak - - - - - - - - - 32
Oil Finish - - - - - - - - 45
Oil,—Rubbing - - - - - - - 27
Pine,—Preparing - - - - - - 13
Preparation Necessary - - - - - 10
Preparation of Woods - - - - - 13
Pumice Stone - - - - - - - 26, 28
Putty - - - - - - - - - 14
Raising Grain - - - - - - - 47
Rosewood - - - - - - - - 44
Rottenstone - - - - - - - 42
Rubbing Oil - - - - - - - - 27
Sandpapering Finish - - 23, 25, 33, 39
Sawdust and Glue - - - - - - 14
Scraping Finish - - - - - - 24
Shellac - - - - - - - 12, 16
Shellacing - - - - - 18, 26, 50
Smoothing Wood - - - - 13, 16, 31
Spruce and Fir - - - - - - 31
Staining Over Filler - - - - - - 37
Stains - - - - - - - 38, 41
Suitable Piece - - - - - - - 11
Taboret,—Finishing - - - - - 43
True Surface - - - - - - - 10
Varnishing - - - - - - - 50
Waste Paper Basket - - - - - - 47
Wax Finish - - - - - - - 46
Whiting - - - - - - - - 14
Why Do Finishing - - - - - - 7

WOODWORK FOR THE GRADES

This is the book usually referred to in Wood Finishing. It is the book for the beginner in using tools, no matter in what grade. Being very complete in both text and illustrations it is therefore an exceptional book for the home mechanic, or the boy who has a few tools and wishes to learn to use them correctly. With this book at hand the parent, tho not a mechanic, should be able to interest and direct the young mechanic to such an extent as to result in first class work and also in learning much of value about tools and their correct use.

The mechanical drawings are arranged and graded with great care so that the average boy will, in using the book, learn to read drawings without any special effort. There are complete working drawings of a large number of projects from simple one-piece projects such as shelves, cutting boards, etc., to chairs, tables and screens. The variety of designs in foot-stools, taborets and bookracks is sufficient to afford work for the boy beginner as well as problems sufficiently complex for the grown-up. The book is meeting with exceptional success in both school and home.

WOODWORK FOR THE GRADES, will be sent by mail prepaid to any address on receipt of one dollar.

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